COMB-CALIBRATED NONLINEAR SPECTROSCOPY OF THE Q(1) 1-0 LINE OF MOLECULAR HYDROGEN

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Molecular hydrogen is the subject of intensive theoretical and experimental studies because of its relevance to benchmark quantum electrodynamics models. We report an accurate study of the Q(1) 1-0 line of H_2 through a nonlinear spectroscopy setup based on Stimulated Raman Scattering (SRS) and comb calibration of the frequency axis. Systematic uncertainties affecting the apparatus, mainly due to pointing instabilities of pump and Stokes beams and to temperature drifts of the gas cell, have been reduced to about 200 kHz, which is comparable to statistical and systematic errors expected from the global fitting of multi-pressure SRS spectra. We performed measurements over two decades of pressure, from 0.05 to 5 bar, using low-pressure spectra to extrapolate the transition frequency of the isolated molecule, and high-pressure spectra to test collisional lineshape models. Our results are likely to be of relevance for a deeper understanding of H_2 physics and for bringing theory-vs-experiment comparison on the Q(1) 1-0 line-centre frequency below 1 MHz.